WHAT IS CLAIMED IS:

1. A method for predicting train consist reactions to specific stimuli using a system including at least one measurement sensor located on a train consist, a data base, and a computer, the train consist including at least one locomotive and at least one railcar, said method comprising the steps of:

collecting sensor data as the consist is moving;

determining a consist force balance utilizing the sensor data and the computer;

determining a set of consist coefficients using the computer; and

predicting train consist kinetic characteristic values using the consist force balance and the set of consist coefficients.

2. A method in accordance with Claim 1 wherein said step of collecting sensor data comprises the steps of:

monitoring a force applied to the consist utilizing the at least one measurement sensor;

generating force data with respect to the force applied; and

communicating the force data to the computer.

3. A method in accordance with Claim 1 wherein said step of determining a consist force balance comprises the step of determining a set of consist kinetic elements.

4. A method in accordance with Claim 3 wherein said step of determining a set of consist kinetic elements comprises the step of determining rolling forces according to the equation $F_{(rf)} = M\ (K_r + K_{rv}\ v(t))$.

5. A method in accordance with Claim 3 wherein said step of determining a set of consist kinetic elements further comprises the step of determining aerodynamic forces according to the equation $F_{(af)} = K_a\ v(t)^2$.

6. A method in accordance with Claim 3 wherein said step of determining a set of consist kinetic elements further comprises the step of determining

elevation caused forces according to the equation $F_{(ef)} = M (K_{e1} E_1(t) + K_{e2} E_2(t) + K_{e3} E_3(t) + K_{e4} E_4(t))$.

7. A method in accordance with Claim 3 wherein said step of determining a set of consist kinetic elements further comprises the step of determining braking forces caused by direction changes according to the equation $F_{(dbf)} = M (K_p C_p(t) + K_l C_l(t))$.

8. A method in accordance with Claim 3 wherein the at least one railcar includes at least one brake shoe, said step of determining a set of consist kinetic elements further comprises the step of determining consist brake forces caused by application of the at least one brake shoe according to the equation $F_{(baf)} = K_{b1} B_1(t) + K_{b2} B_2(t) + K_{b3} B_3(t) + K_{b4} B_4(t)$.

9. A method in accordance with Claim 8 wherein said step of determining consist brake forces caused by application of the at least one brake shoe further comprises the steps of:

determining friction coefficients of the at least one brake shoe;

determining total brake application forces; and

determining total brake release forces.

10. A method in accordance with Claim 9 wherein said step of determing total brake application forces comprises the step of determining a brake application dragging force using a fast building pressure model according to the equation

$$Bf_f = \min(0, \max(1, (T + 3.86950758 * T^2 + 0.23164628 * T^3) / (16367.9101 + 111.652789 * T + 27.6134504\ 8 * T^2 - 0.0026229 * T^3)))\ Bcf.$$

11. A method in accordance with Claim 9 wherein said step of determining total brake application forces comprises the step of determining a brake application dragging force using a slow building pressure model according to the equation

$$Bf_s = \min(0, \max(1, (T_s + 2.00986206 * T_s^2 + 0.81412194 * T_s^3) /$$

$(0.00067603 + 169.361303 * T_S + 8.95254599 * T_S^2 + 0.58477705 * T_S^3)))\ Bc_S$.

12. A method in accordance with Claim 9 wherein said step of determining total brake release forces comprises the step of determining brake release using a fast release model according to the equation

$$Rf_f = \min(0, \max(1, (t + 3.86950758 * t^2 + 0.23164628 * t^3) / (16367.9101 + 111.652789 * t + 27.6134504\ 8 * t^2 - 0.0026229 * t^3)))\ Bcf.$$

13. A method in accordance with Claim 9 wherein said step of determining total brake release forces comprises the step of determining brake release using a slow release model according to the equation

$$Rf_s = \min(0, \max(1, (t + 2.00986206 * t^2 + 0.81412194 * t^3) / (0.00067603 + 169.361303 * t + 8.95254599 * t^2 + 0.58477705 * t^3)))\ Bc_S.$$

14. A method in accordance with Claim 3 wherein said step of determining a set of consist kinetic elements further comprises the step of determining dynamic brake force according to the equation $F_{(dbf)} = K_d D(t)$.

15. A method in accordance with Claim 3 wherein said step of determining a set of kinetic elements further comprises the step of determining traction force.

16. A method in accordance with Claim 3 wherein said step of determining a force balance further comprises the step of summing the set of consist kinetic elements.

17. A method in accordance with Claim 1 wherein said step of determining a set of consist coefficients comprises the step of using a least squares method to determine consist coefficients.

18. A method in accordance with Claim 17 wherein said step of using the least squares method comprises the steps of:

weighting data;

solving the system; and

determining a confidence measure.

19. A method in accordance with Claim 1 wherein said step of predicting consist characteristic values comprises the steps of:

determining an acceleration prediction;

determining a speed after one minute prediction using the acceleration prediction; and

determining a shortest braking distance prediction using the acceleration prediction.

20. A method in accordance with Claim 19 wherein said step of determining an acceleration prediction comprises the steps of:

determining initial values; and

storing the initial values in the database.

21. A method in accordance with Claim 20 wherein said step of determining an acceleration prediction further comprises the step of determining the acceleration prediction value using a Euler method and the determined initial values.

22. A method in accordance with Claim 20 wherein said step of determining an acceleration prediction further comprises the step of determining the acceleration prediction value using a Milne method and the determined initial values.

23. A system for predicting reactions of a train consist to specific stimuli, said system comprising at least one measurement sensor located on the train consist, a data base, and a computer, the train consist comprising at least one locomotive and at least one railcar, said system configured to:

collect sensor data as the consist is moving;

determine a consist force balance utilizing the sensor data and said computer;

determine a set of consist coefficients using said computer; and

predict train consist kinetic characteristic values using the consist force balance and the set of consist coefficients.

24. A system in accordance with Claim 23 wherein to collect sensor data said system further configured to:

monitor a force applied to the consist utilizing said at least one measurement sensor;

generate force data with respect to the force applied; and

communicate the force data to said computer.

25. A system in accordance with Claim 23 wherein to determine a consist force balance, said system further configured to determine a set of consist kinetic elements.

26. A system in accordance with Claim 25 wherein to determine a set of consist kinetic elements, said system further configured to determine rolling forces according to the equation $F_{(rf)} = M (K_r + K_{rv} v(t))$.

27. A system in accordance with Claim 25 wherein to determine a set of consist kinetic elements, said system further configured to determine aerodynamic forces according to the equation $F_{(af)} = K_a v(t)^2$.

28. A system in accordance with Claim 25 wherein to determine a set of consist kinetic elements, said system further configured to determine elevation caused forces according to the equation $F_{(ef)} = M (K_{e1} E_1(t)+ K_{e2} E_2(t)+ K_{e3} E_3(t)+ K_{e4} E_4(t))$.

29. A system in accordance with Claim 25 wherein to determine a set of consist kinetic elements, said system further configured to determine braking forces caused by direction changes according to the equation $F_{(dbf)} = M (K_p C_p(t) + K_l C_l(t))$.

30. A system in accordance with Claim 25 wherein said at least one railcar comprises at least one brake shoe, and to determine a set of consist kinetic elements, said system further configured to determine consist brake forces caused by application of said at least one brake shoe according to the equation $F_{(baf)} = K_{b1} B_1(t)+ K_{b2} B_2(t)+ K_{b3} B_3(t)+ K_{b4} B_4(t)$.

31. A system in accordance with Claim 30 wherein to determine consist brake forces caused by application of said at least one brake shoe, said system further configured to:

determine friction coefficients of said at least on brake shoe;

determine total brake application forces; and

determine total brake release forces.

32. A system in accordance with Claim 31 wherein to determine total brake application forces, said system further configured to determine a brake application dragging force using a fast building pressure model according to the equation

$$Bf_f = \min(0, \max(1, (T + 3.86950758 * T^2 + 0.23164628 * T^3) / (16367.9101 + 111.652789 * T + 27.6134504\ 8 * T^2 - 0.0026229 * T^3)))\ Bcf.$$

33. A system in accordance with Claim 31 wherein to determine total brake application forces, said system further configured to determine a brake application dragging force using a slow building pressure model according to the equation

$$Bf_s = \min(0, \max(1, (T_s + 2.00986206 * T_s^2 + 0.81412194 * T_s^3) / (0.00067603 + 169.361303 * T_s + 8.95254599 * T_s^2 + 0.58477705 * T_s^3)))\ Bc_s.$$

34. A system in accordance with Claim 31 wherein to determine total brake release forces, said system further configured to determine brake release using a fast release model according to the equation

$$Rf_f = \min(0, \max(1, (t + 3.86950758 * t^2 + 0.23164628 * t^3) / (16367.9101 + 111.652789 * t + 27.6134504\ 8 * t^2 - 0.0026229 * t^3)))\ Bcf.$$

35. A system in accordance with Claim 31 wherein to determine total brake release forces, said system further configured to determine brake release using a slow release model according to the equation

$Rf_s = \min(0, \max(1, (t + 2.00986206 * t^2 + 0.81412194 * t^3) / (0.00067603 + 169.361303 * t + 8.95254599 * t^2 + 0.58477705 * t^3)))$

Bc_S.

36. A system in accordance with Claim 25 wherein to determine a set of consist kinetic elements, said system further configured to determine dynamic brake force according to the equation $F_{(dbf)} = K_d D(t)$.

37. A system in accordance with Claim 25 wherein to determine a set of kinetic elements, said system further configured to determine traction force.

38. A system in accordance with Claim 25 wherein to determine a force balance, said system further configured to sum said set of consist kinetic elements.

39. A system in accordance with Claim 23 wherein to determine a set of consist coefficients, said system further configured to use a least squares method to determine consist coefficients.

40. A system in accordance with Claim 39 wherein to use the least squares, said system further configured to:

weight data;

solve the system; and

determine a confidence measure.

41. A system in accordance with Claim 23 wherein to predict consist characteristic values, said system further configured to:

determine an acceleration prediction;

determine a speed after one minute prediction using said acceleration prediction; and

determine a shortest braking distance prediction using said acceleration prediction.

42. A system in accordance with Claim 41 wherein to determine an acceleration prediction, said system further configured to:

determine initial values; and

store the initial values in said database.

43. A system in accordance with Claim 42 wherein to determine an acceleration prediction, said system further configured to determine the acceleration prediction value using a Euler method and said determined initial values.

44. A system in accordance with Claim 20 wherein to determine an acceleration prediction, said system further configured to determine the acceleration prediction value using a Milne method and the determined initial values.

45. A method for determining a force balance for a train consist using a system including at least one measurement sensor located on the train consist, a data base, and a computer, the train consist including at least one locomotive and at least one railcar, the railcar including at least on brake shoe, said method comprising the steps of:

monitoring a force applied to the consist utilizing the at least one measurement sensor;

generating force data with respect to the force applied;

communicating the force data to the computer;

determining rolling forces according to the equation $F_{(rf)} = M (K_r + K_{rv} v(t))$;

determining aerodynamic forces according to the equation $F_{(af)} = K_a v(t)^2$;

determining elevation caused forces according to the equation $F_{(ef)} = M (K_{e1} E_1(t)+ K_{e2} E_2(t)+ K_{e3} E_3(t)+ K_{e4} E_4(t))$;

determining braking forces caused by direction changes according to the equation $F_{(dbf)} = M (K_p C_p(t) + K_l C_l(t))$;

determining consist brake forces caused by application of the at least one brake shoe according to the equation $F_{(baf)} = K_{b1} B_1(t)+ K_{b2} B_2(t)+ K_{b3} B_3(t)+ K_{b4} B_4(t)$;

determining brake application dragging force using a fast building pressure model according to the equation

$$Bf_f = \min(0, \max(1, (T + 3.86950758 * T^2 + 0.23164628 * T^3) / (16367.9101 + 111.652789 * T + 27.6134504\ 8 * T^2 - 0.0026229 * T^3)))\ Bc_f;$$

determining brake application dragging force using a slow building pressure model according to the equation

$$Bf_s = \min(0, \max(1, (T_s + 2.00986206 * T_s^2 + 0.81412194 * T_s^3) / (0.00067603 + 169.361303 * T_s + 8.95254599 * T_s^2 + 0.58477705 * T_s^3);$$

determining brake release using a fast release model according to the equation

$$Rf_f = \min(0, \max(1, (t + 3.86950758 * t^2 + 0.23164628 * t^3) / (16367.9101 + 111.652789 * t + 27.6134504\ 8 * t^2 - 0.0026229 * t^3)))\ Bc_f;$$

determining brake release using a slow release model according to the equation

$$Rf_s = \min(0, \max(1, (t + 2.00986206 * t^2 + 0.81412194 * t^3) / (0.00067603 + 169.361303 * t + 8.95254599 * t^2 + 0.58477705 * t^3)))\ Bc_s;$$

determining dynamic brake force according to the equation $F_{(dbf)} = K_d D(t)$;

determining traction force; and

determining a final solution according to the equation

$$\begin{gathered} F(t) = M (K_r + K_{rv} v(t)) + K_a v(t)^2 + \\ M K_{e1} E_1(t) + M K_{e2} E_2(t) + M K_{e3} E_3(t) + M K_{e4} E_4(t) + \\ M K_p C_p(t) + M K_l C_l(t) + \\ K_{b1} B_1(t) + K_{b2} B_2(t) + K_{b3} B_3(t) + K_{b4} B_4(t) + \\ K_{r1} R_1(t) + K_{r2} R_2(t) + K_{r3} R_3(t) + K_{r4} R_4(t) + K_d D(t) + K_t T(t). \end{gathered}$$